STRATEGIC PLAN
for
NASA'S

SHORT-TERM PREDICTION AND RESEARCH TRANSITION (SPORT) PROGRAM
2009 - 2014

MARSHALL SPACE FLIGHT CENTER
EARTH SCIENCE OFFICE

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EXECUTIVE SUMMARY

Established in 2002 to demonstrate the weather and forecasting application of real-time EOS measurements, ***the SPoRT program has grown to be an end-to-end research to operations activity focused on the use of advanced NASA modeling and data assimilation techniques, nowcasting techniques, and unique high-resolution multispectral observational data from EOS satellites to improve short-term weather forecasts***. SPoRT currently partners with several universities and other government agencies for access to real-time data and products, and works collaboratively with them to develop new products and infuse these capabilities into the operational weather environment. While the majority of the SPoRT end users are forecasters at various at WFOs in the Southern Region, the inclusion of private sector users in SPoRT shows the relevance of NASA data and research capabilities to a broader segment of the weather community. In this way, ***SPoRT strives to be a focal point and facilitator for the transfer of NASA Earth science technologies to the operational weather community with an emphasis on short-term forecasting***.

To achieve this vision, the SPoRT project will address new data and technologies and develop and test solutions to critical forecast problems, and then integrate solutions into end user decision support tools. SPoRT will extend and enhance its current capabilities with MODIS, AMSR-E, and AIRS, total lightning measurements from ground-based networks and work with existing WFOs by partnering with new organizations and end users that have significant forecast needs that can be met by SPoRT objectives. New areas of focus will include fire weather and wildfire forecast problems, land falling hurricane track and intensity forecasts, NPOESS data and the AWIPS II. Over the next few years, SPoRT will enhance partnerships with NOAA / NESDIS for new product development and data access to exploit the remote sensing capabilities of instruments on the NPOESS satellites to address short term weather forecasting problems. The VIIRS and CrIS instruments on the NPP and follow-on NPOESS satellites provide similar observing capabilities to the MODIS and AIRS instruments on Terra and Aqua.

The NWS is embarking on a new generation of information systems to aid forecasters in the development and dissemination of forecast products to the public. The next generation system, called AWIPS II, will be deployed beginning in the Fall of 2009. The architecture will allow for more flexibility in the use of new data sets and to enhance visualization of data streams where the old system was too constraining. SPoRT will transition NASA and NPOESS observing capabilities to the AWIIPS II environment to continue the continuity and growth of the transitional activities. Additionally, new display capabilities which better portray the four-dimensional variability of total lightning data will be developed and transitioned for use in AWIPS II.

The SPoRT program will evolve to stay relevant to the changing needs of NASA research objectives and forecast issues in the Earth and atmospheric science community. Most of the current end users reside at the NWS WFOs, but expansion to include other government and private sector end users is seen as a bridge between the Research and Analysis program and Applied Sciences programs at NASA Headquarters. This will also open up opportunities for

other ESO and NSSTC staff to become involved with SPoRT, leveraging of SPoRTs success and core capabilities to expand work in other R&A and Applied Science areas. SPoRT will also strengthen ties with NOAA NESDIS to transition new observational datasets into advanced decision support tools.

The execution of this strategy requires the support of civil service leadership and technical expertise in core areas, including atmospheric electricity, regional modeling and data assimilation and remote sensing, and supporting technical expertise and transitional skills of associated research scientists and graduate students. Maintaining this blend of manpower is critical to the continued success of the SPoRT program. SPoRT will strengthen its civil service technical capabilities and core leadership through new NASA hiring opportunities and backfilling slots of transitioned or retiring scientists, and will use university and private sector research scientist support to augment required expertise.

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1. INTRODUCTION

This strategic plan document articulates the purpose of the Short-term Prediction Research and Transition (SPoRT) project and presents achievable goals and objectives for the 2009-2014 time period. The process to develop this plan was introspective and extrospective. The internal self-analysis process focused on the realization of where we have been by reflecting on our accomplishments and the generation of a comprehensive strength-weakness-opportunity-threat (SWOT) analysis which helped defined the past and present state of the team. The external assessment was generated based on partner and end user feedback and reports from an external peer-group from within the Earth science community which serves as the SPoRT Science Advisory Committee (SAC). The project goals and objectives have been refined over the last few years and still reflect the original intent of the project proposed to NASA in 2002. The vision presented in this plan is ambitious, but one which can be obtain and will fulfill our mission The distribution of the strategic plan to our stakeholders, beneficiaries, partners, end users and the external science community will help communicate SPoRT's mission and ensure effective use of the project's resources by focusing on the research to operation priorities. The plan will also provide a baseline from which progress can be measured.

The SPoRT project is funded by the Research and Analysis (R & A) program of the Earth Science Division (ESD) and Science Mission Directorate (SMD) at NASA Headquarters. A key component of the SMD is to understand and protect our home planet by using our view from space to study the Earth system and improve prediction of Earth system changes. The execution of this strategy involves the interaction with operational weather entities to include (1) participation in the development of preparatory instruments for application to various operational environmental satellite systems, (2) development of new data products originating from space-based observing systems, and (3) collaboration in the development and experimentation of improved atmospheric models and data assimilation schemes. SPoRT contributes to this effort by transitioning unique NASA data and research capabilities to the operational weather community to improve short-term weather forecasts on a regional and local scale.

2. CURRENT ENVIRONMENT

The NASA Marshall Space Flight Center (MSFC) Earth Science Office (ESO) located at the National Space Science and Technology Center (NSSTC) provides the infrastructure to conduct the SPoRT project to help SMD carry out its mission. SPoRT works to accelerate the infusion of unique NASA Earth science observations, data assimilation and modeling research to the operational weather community to improve short-term weather forecasts at the regional and local scale. In the process of executing this mission, SPoRT strives to obtain the following overarching project goals:

1) evaluate and assess the utility of NASA Earth science data and products, and unique research capabilities to address operational weather forecast problems in the southeast United States,
2) develop an end-to-end framework to transition research capabilities to the operational weather community,
3) provide an environment to enable the development and testing of new capabilities to improve short-term weather forecasting on a regional scale, and
4) ensure the successful transition of new capabilities to operational entities for the benefit of society.

SPoRT works under a Memorandum of Understanding (MOU) with the NWS Southern Region (SR) Headquarters and selected Weather Forecast Offices (WFOs) in the SR to obtain these goals. It also actively embraces partnerships with NOAA / National Environmental Satellite, Data, and Information Service (NESDIS), the NASA / Goddard Space Flight Center (GSFC) Global Modeling and Assimilation Office (GMAO), NASA / NOAA /DoD Joint Center for Satellite Data Assimilation (JCSDA), and other government agencies and university partners through Space Act and Cooperative Agreements. The SPoRT program also works closely with the SMD's Applied Science program to demonstrate the utility of NASA research results to many of its eight application areas.

2.1. Infrastructure

The MSFC's Earth Science Office currently resides at the NSSTC, a collaborative Earth, atmospheric, and space science research center involving partnerships with the seven research universities in Alabama. The ESO is also physically collocated with the University of Alabama's Atmospheric Science Department, the UAH Earth System Science and Global Hydrology Resource Centers, and the Huntsville NWS Weather Forecast Office (WFO). The Huntsville WFO is one of 32 offices in the Southern Region and is responsible for production and dissemination of weather forecasts for 11 north Alabama and 3 southern Tennessee counties. It is also the only WFO collocated with a NASA facility. Unique to the Huntsville WFO is a shared Collaborative Research Area (CRA) located adjacent to the operations floor in the WFO where scientists from NASA, NOAA, and UAH work collaboratively in a testbed environment to develop new forecasting tools and capabilities. The CRA contains several AWIPS workstations where scientists develop and test capabilities to be transitioned into the operational weather environment. SPoRT staff members also have access to state of the art computational resources

from their desktops, including numerous dual processor workstations and multiple node Linux clusters, and extensive data ingest and storage capabilities. Real-time GOES data is ingested via dual roof-top antennas and direct broadcast EOS data is obtained in real-time from collaborative partners via the Internet. SPoRT staff members also make extensive use of GSFC and the JCSDA supercomputer resources for many of the numerical model forecasts and data assimilation activities.

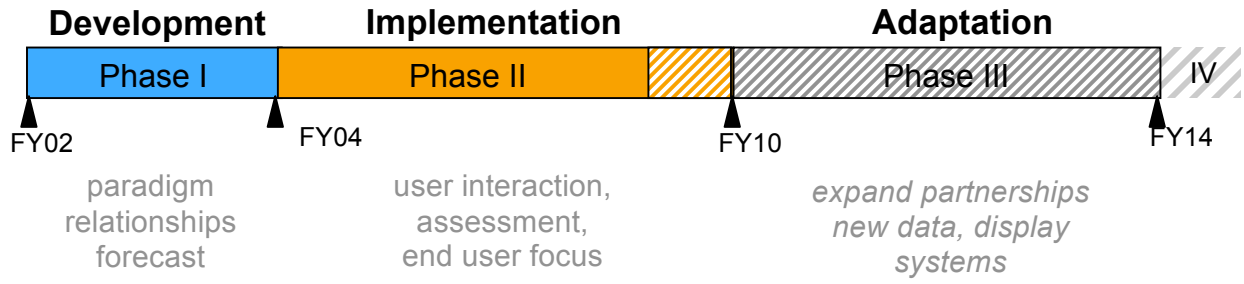
SPoRT personnel comprise a small subset of staff associated with the Earth and atmospheric activities in the NSSTC which total about 150 degreed scientists, making it one of the largest Earth science research facilities in the southeast United States. The collocation of NASA, UAH, and the Huntsville WFO under one roof represents a one-of-kind capability for the transition of unique Earth and atmospheric science to the operational weather community and is a key component to the success of the SPoRT project..

2.2. Focus

The concept of using NASA EOS observations to improve weather forecasting developed out of a number of discussions between NASA / MSFC and Earth science program managers at NASA Headquarters in 2001. Several key activities were occurring around this time that facilitated the concept of a regional center to transition EOS data to the operational weather community. NASA was about to launch one of its new EOS satellites to continue to make global observations of the Earth-atmosphere-ocean system to better understand the Earth's climate and how it might be changing. Additionally, numerous low-cost direct broadcast ground receiving stations were being installed across the country to make MODIS, AIRS, and AMSR-E data available to the user community in real time. At the same time, NOAA was planning to relocate and open a new weather forecast office in Huntsville, Alabama in association with NASA scientists, and the atmospheric research and educational components of the University of Alabama in Huntsville. The potential synergy between the three organizations working together to advance weather diagnostic, nowcasting, and forecasting techniques as a result of the EOS program was electrifying. NASA / MSFC scientists developed a proposal to use EOS observations from the direct broadcast data streams across the country to do just that. The initial and subsequent follow-on proposal was funded by NASA to facilitate the use of EOS data in NWS forecast offices to improve short-term weather prediction.

The SPoRT program has undergone significant development since its inception in 2001. The program is currently in the second phase of a multiphase project. The initial developmental focused on working closely with NOAA / NWS staff to understand how they do business, identifying forecast problems and matching them to unique NASA observational and modeling capabilities, and establishing a successful paradigm for the transition of research capabilities to the operational weather environment. Early successes with MODIS data, local lightning detection, and regional modeling activities provided encouragement for the second phase of the project. In the second phase, SPoRT has focused on the end user, their forecast problems, and assessing the impact NASA observations have on the weather service operations at the local WFO level. The project currently works with 13 NWS forecast offices and several private sector end users to show the utility of NASA research capabilities. SPoRT also has provided other

groups (external to the NSSTC) with the tools and technology to transition additional data and research capabilities to a broader segment of the community, including the private sector. As SPoRT plans for the third phase of the project, it will adapt its methodologies to the changing needs of NASA and the end user community including the application of new satellite sensors systems and new decision support tools.



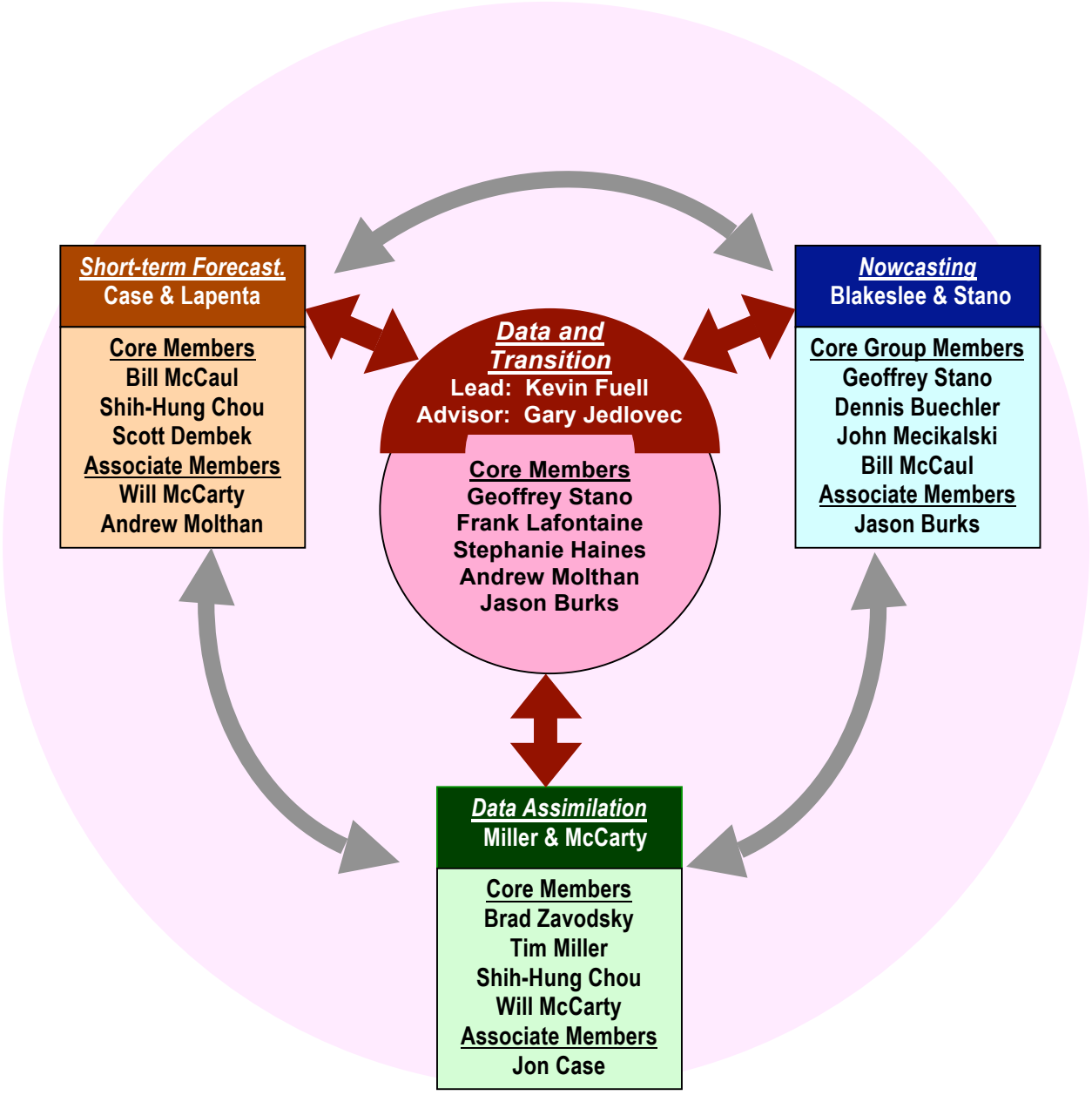
2.3. Staff

SPoRT is functionally organized into four working groups led by a management and integration team consisting of the SPoRT Co-Principal Investigators (Co-PIs), a NASA Project Manager (PM), and Huntsville NWS office senior leadership. The functional diagram below lays out this group structure. The Co-PIs look both outward and inward and provide technical direction to the project functions and relevance to NASA needs. The PIs and Huntsville NWS collaborators are also active participants in the working groups. The PM assists the Co-PIs in running day-to-day activities and other project management activities.

The short-term forecasting, data assimilation, and nowcasting groups represent three technical areas whose scientists conduct cutting edge research related to operational weather forecasting. The groups draw on in-house technical expertise from NASA, UAH, and collaborative research partners, much of which has been existence at NASA and UAH for the last twenty years. The ongoing major projects currently addressed by these groups is are listed below. The ***short-term forecasting group*** concentrates on regional weather forecast model expertise to link these models with other unique NASA research capabilities. The Weather Research and Forecast (WRF) model is the primary forecast tool which is run regularly to demonstrate the impact of NASA observations on improvements in short-term weather forecasts. Development work links the GSFC Land Information System (LIS) to the WRF to assess the impact of surface forcing on model forecasts. Similarly, selected model runs in a case study and near-real time mode demonstrate the impact of AIRS radiance and profile data, and MODIS SST composites on the regional scale. The ***data assimilation group*** works closely with the remote sensing experts and short-term forecasting group to devise the best strategies to assimilate NASA remote sensing observations with the models. Assimilation techniques which rely on both the Gridpoint Statistical Interpolator (GSI) and other 3-D Variational approaches in various versions of the WRF are developed, tested and integrated into quasi-operational processing schemes. The resulting enhanced initial fields feed the models used by the forecasting group. The ***nowcasting group*** focuses on the use of real-time data streams, total lightning data, and a suite of nowcasting

products (observational data and associated derived products) to address observational and very short term weather forecasting problems. The ***data and transition group*** provides remote sensing expertise and integrates research with weather forecast problems and facilitates the transition of beneficial capabilities to the operation forecasting environment. It also focuses on training, and the assessment of new forecast capabilities in the WFO or end user environment. It also explicitly includes NWS information technology and forecasting staff to facilitate successful transitions. One should note that there is considerable interaction of personnel between the groups, and a mix of personnel from various organizations in each group. This mix brings a dynamic blend of perspectives and expertise to each group.

Co-PIs	Project Manager	NWS Collaborators
Gary Jedlovec & Bill Lapenta	Melody Herrmann	Chris Darden Jason Burks
	Support	Mike Coyne
Paul Meyer	Diane Samuelson	Erik Reimers



Major projects

Short-term Forecasting

- Use of high resolution SST composites in regional forecast models
- Lightning forecasts with the WRF
- Coupled WRF / LIS sensitivity studies for surface parameter impact
- Adjustments of WRF microphysical schemes based on CloudSat data
- Impact of AIRS data on WRF forecasts

Data assimilation

- AIRS profile assimilation with WRF / Var
- AIRS radiance assimilation with GSI, emphasis on cloud detection

Nowcasting

- Total lightning data for severe weather forecasting - source and flash densities, lightning warnings
- Enhanced surface product analysis for diagnostic evaluation
- Convective initiation products for increased situational awareness

Data and transition

- New products to WFO operations – focus on existing products to new WFOs, and new products (CI, CIRA TPW and MIMIC TPW, GOES Aviation Products)
- Data dissemination mechanisms for reduced latency – exclusive use of LDM for reduced latency of shared products
- Forecaster training and science sharing – various new modules for WFOs
- Product assessments – natural and false color imagery, LMA data, etc.

2.4. Budget overview

The SPoRT project is funded by the R&A program of the ESD at NASA Headquarters. The SPoRT funding profile has increase commensurate with the expansion of the program and the increase in staff and technical experts to address the particular project goals. In the formulation or development phase of the project, base level of funding was used to establish partnerships, identify relevant forecast problems, and to begin some early transition activities which led to the successful SPoRT paradigm for the transition of research capabilities to the operational community. Additional funding was obtain to over time to support new transitional activities which were more broadly implement in the operational weather community over time.

3. STRATEGIC APPROACH

This section describes strategies and functional objectives developed over the last few years to provide overall guidance for research and transitional activities of the SPoRT project. The strategies identify areas of emphasis, key technical components of the project, funding goals, and an appropriate staffing plan that are essential for the continued success of the SPoRT program.

The SPoRT staff achieves the overall project goals by implementing these strategies:

1) ***develop and execute a one-of-a-kind program to effectively transition unique Earth science research capabilities to operational weather entities to better serve society, though collaborative and supporting partnerships with the NOAA / NWS, its regional offices and local WFOs, and with other government, university, and private sector partners,***
2) ***identify focus areas for research and transition consistent with NASA's decadal survey (NRC, 2007) and mission initiatives and in conjunction with collaborative partners and an external advisory group convened regularly to provide community guidance and direction to the SPoRT program,***
3) ***seek and maintain world class scientific expertise in key focus areas drawing on civil service leadership and technical expertise for those areas, and in-house and external supporting scientists to provide other technical capabilities and liaison activities, and***
4) ***broaden the focus of SPoRT to include weather related activities within NASA's Applied Science program, and explore other external funding opportunities which leverage off core capabilities, infrastructure, and transitional experience to execute new initiatives.***

By following these project strategies, SPoRT will be positioned to be an Agency focal point and facilitator for the transfer of NASA Earth science technologies to the operational weather community focused on short-term weather forecasts. The specific project objectives listed below for both research and transition and programmatic activities expand on the SPoRT strategic objectives and guide the individual groups in their month-to-month activities.

3.1 Research and transition objectives:

1) Forecast problems: identify forecast problems common to the WFOs in the southeast United States, which can be linked to NASA data, research capabilities, and science issues identified in the NASA Strategic and Science Plans (NASA, 2006; NASA, 2007) and Decadal Survey (NRC, 2007), for which solutions are available or can be developed in a reasonable timeframe,
2) Facilitation: facilitate the successful transfer and use of NASA research products to WFOs and other end users through joint projects, workshops, personnel exchanges, site visits, and other activities which foster partnerships leading to successful transitions,
3) Areas of emphasis: focus research and transitional activities on core expertise areas including, but not limited to, the detection of total lightning and its nowcasting potential, the

use of passive remote sensing observations of the atmosphere, surface and oceans, and regional weather model development and assimilation strategies to improve initial conditions and subsequent model short-term (0-48h) weather forecasts on a regional scale,

4) Advanced decision support tools: adapt transitional activities to include advances in decision support system capabilities such as AWIPS II and other public and private sector technologies,

5) Capabilities and assessments: develop and implement tools and conduct controlled experiments to assess the impact and benefits of transitioned NASA research capabilities to the operational weather community, and

6) Training: develop and disseminate appropriate visual modules and other training tools to education forecasters and other users on the use of new satellite data, model forecasts, and other capabilities transitioned to the operational weather community.

3.2 Programmatic objectives

7) Observational platforms: utilize existing NASA EOS observational resources, new instruments (on future NPOESS and GOES-R) and other observing capabilities being developed by NASA and collaboratively with its partners, and those specified under new NASA mission plans and the Decadal Survey (NRC, 2007),

8) Partnerships: partner with government, university, and private sector entities to demonstrate the utility of NASA Earth science research capabilities to other end users,

9) Other agency end users: work collaboratively with Government agencies including the NWS, NESDIS, and JCSDA to extend the SPoRT paradigm to facilitate new research transitions in their agencies, and

10) Manpower: maintain civil service workforce in key expertise areas of atmospheric electricity, modeling and data assimilation, and remote sensing in order to continue the success of the project, striving to obtain "two-deep" leadership and expertise at the civil service level by hiring a younger technical work force to replace departing senior leadership.

3.3 Metrics

The success of the SPoRT program will be measured in a number of ways; with peer-reviewed publications, transitional successes, community recognition, and end user satisfaction.

- Successful transitions - While the transition of a variety of new products and research capabilities to the end user community is an important metric, the impact of the product and the satisfaction with and the continued use of the NASA research capabilities is equally important for both products transitioned and tools developed and provided to others to carry-out successful transitions. Feedback on the success of these transitions will be obtained through user surveys and documented in assessment studies and reports.

- Community recognition – While the success of transitioned products to WFOs is an important metric, community recognition of SPoRT as an important partner to help facilitate other transitions is equally important. Recognition of SPoRT as "the place to go" for help in the transition of unique NASA weather products to operational weather community demonstrates the success of the program. Additionally, newly developed transitional activities undertaken by other agencies utilizing the SPoRT paradigm, capabilities, or information are an additional measure of project success.

- Peer-reviewed publications – Peer-reviewed publications on the new research and transitional capabilities and techniques used to develop them are a key metric to document the success of the project. The publication rate may depend on the changing emphasis of the project, where, from time-to-time, more emphasis is put on transition rather than research. Publication of transitional results and assessments are also appropriate although not always in peer-reviewed forums.

4. VISION FOR THE FUTURE

Established in 2002 to demonstrate the weather and forecasting application of real-time EOS measurements, the SPoRT program has grown to be an end-to-end research to operations activity focused on the use of advanced modeling and data assimilation techniques, nowcasting, and unique high-resolution multispectral observational data to improve short-term weather forecasts. SPoRT currently partners with several universities and other government agencies for access to real-time data and products, and works collaboratively with them to develop new products for the transition to the operational weather environment. Additionally, new collaborations have been established through peer-reviewed support resulting from successful ROSES07 proposals and collaborative research agreements with other federal agencies. While the majority of the SPoRT end users are forecasters at various at WFOs in the Southern Region (12 of the 13 offices), the inclusion of private sector users in SPoRT shows the relevance of NASA data and research capabilities to a broader segment of the weather community. In this way, ***SPoRT strives to be focal point and facilitator for the Agency for the transfer of NASA Earth science technologies to the operational weather community focused on short-term weather forecasting***.

To achieve this vision, the SPoRT project will evolve to address new data and technologies and develop and test solutions to critical forecast problems, and then integrate tested solutions into end user decision support tools. SPoRT will extend and enhance its current capabilities with MODIS, AMSR-E, and AIRS, total lightning measurements from ground-based networks at existing WFOs, and look to partner with new entities that have significant forecast needs relevant to the SPoRT project objectives.

New areas of focus will include fire weather and wildfire forecast problems, land falling hurricane track and intensity forecasts, NPOESS data and the AWIPS II. Other areas will be determined as new issues and data arise. Recent episodes of wildfires across the country have created a series of forecast issues for WFOs to provide weather support for federal response teams, which not only include short term forecast of environmental conditions but also local and regional visibility and air quality problems. Post fire weather conditions which include heavy rains forecasted on burn areas can create additional environmental problems which WFOs are involved. Active fire and burn area information integrated into AWIPS will be invaluable to forecasters to support their constituents and customers in other agencies and the public. SPoRT's success showing the positive impact of high resolution SST composites on weather forecasts in coastal regions will lead to new activities to reduce product latency using AMSR-E data. The enhanced composite will be used on an experimental basis in hurricane models run by groups such as NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML).

Over the next few years, SPoRT will enhance partnerships with NOAA / NESDIS for new product development and data access to exploit the remote sensing capabilities of instruments on the NPOESS satellites to address short term weather forecasting problems. The VIIRS and CrIS instruments on the NPP and follow-on NPOESS satellites provide similar observing capabilities to the MODIS and AIRS instruments on Terra and Aqua. The NPOESS program will provide level 1 data and a suite of level 2 products relevant to weather forecasting; with the data will be

available to the community via a provider-subscriber relationship. SPoRT will expand its collaborations with the NESDIS via the NPOESS Data Exploitation (NDE) project to bring these unique NPOESS measurements to WFOs to address pending forecast issues.

The NWS is embarking on a new generation of information systems and decision tools to aid forecasters in the development and dissemination of forecast products to the public. The next generation system, called AWIPS II, will be deployed beginning in the Fall of 2009. The architecture will allow for more flexibility in the use of new data sets and to enhance visualization of data streams where the old system was too constraining. SPoRT will transition NASA and NPOESS observing capabilities to the AWIPS II environment to continue the continuity and growth of the transitional activities. Additionally, new display capabilities which better portray the four-dimensional variability of total lightning data will be developed and transitioned for use in AWIPS II.

The SPoRT program will evolve to stay relevant to the changing needs of NASA research objectives and forecast issues in the Earth and atmospheric science community. Most of the current end users reside at the NWS WFOs, but expansion to include other government and private sector end users is seen as a bridge between the R&A and Applied Sciences programs at NASA Headquarters. This will also open up opportunities for other ESO and NSSTC staff to become involved with SPoRT, leveraging off SPoRT's success and core capabilities to expand work in other R&A and Applied Science areas. SPoRT will also strengthen ties with NOAA and its supporting organizations to transition new observational datasets into advanced decision support tools. Thus, the vision for 2011 shows enhanced collaborations with NESDIS as a collaborative partner to transition NPP / NPOESS data to the appropriate user community and with advanced display capabilities in the next generation display systems such as AWIPS II. Beyond 2011, transitional opportunities will involve a broader range of collaborators and end users to exploit the unique characteristics of satellite data and other unique research capabilities. Measurements from new sensors such as the Soil Moisture Active and Passive (SMAP), the GEOstationary - Coastal and Air Pollution Events (GEO-CAPE), and the Geostationary Lightning Mapper (GLM) will provide enhanced opportunities for SPoRT to transition new observations and capabilities to a broader set of end users.

The execution of this strategy requires the support of civil service leadership and technical expertise in core areas, including atmospheric electricity, regional modeling and data assimilation and remote sensing, and supporting technical expertise and transitional skills of associated research scientists and graduate students. Maintaining this blend of manpower is critical to the continued success of the SPoRT program. SPoRT will strengthen its civil service technical capabilities and core leadership through NASA new hiring opportunities, backfilling slots of transitioned or retiring scientists, and with the use of university and private sector research scientist support. An active student workforce will provide educational opportunities in the key technical areas with first hand experience working collaboratively with the operational weather community.

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